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HCI is a multidisciplinary field focused on human aspects of the development of computer technology. As computer-based technology becomes increasingly pervasive – not just in developed countries, but worldwide – the need to take a human-centered approach in the design and development of this technology becomes ever more important. For roughly 30 years now, researchers and practitioners in computational and behavioral sciences have worked to identify theory and practice that influences the direction of these technologies, and this diverse work makes up the field of human-computer interaction. Broadly speaking it includes the study of what technology might be able to do for people and how people might interact with the technology. The HCI series publishes books that advance the science and technology of developing systems which are both effective and satisfying for people in a wide variety of contexts. Titles focus on theoretical perspectives (such as formal approaches drawn from a variety of behavioral sciences), practical approaches (such as the techniques for effectively integrating user needs in system development), and social issues (such as the determinants of utility, usability and acceptability).

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John N.A. Brown

Anthropology-Based Computing

Putting the Human in Human-Computer Interaction

Springer

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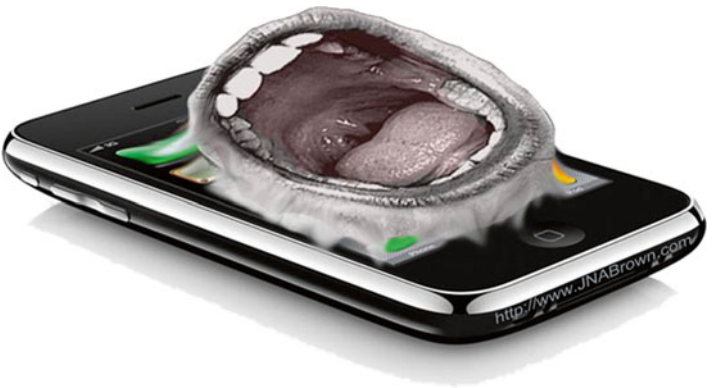
[This book] is unavoidably affirmative and therefore unavoidably autobiographical. The writer has been driven back upon somewhat the same difficulty as that which beset Newman in writing his Apologia; he has been forced to be egotistical only in order to be sincere. While everything else may be different the motive in both cases is the same. It is the purpose of the writer to attempt an explanation…

G.K. Chesterton,
from his introduction to Orthodoxy, 1909

To all of my teachers and students,
past, present, and future…
…deliberate, incidental, accidental,
and inverse


http://www.JNABrown.com/

Introduction

This book is an attempt to share the thinking that went in to developing a new theory of how interaction with computers should be designed. As a result, the reader will be presented with information coming from a wide variety of fields. This work offers an overview of those fields, pulling up some details from one or the other in turn, but not the incisive and definitive work of an expert.

It might help to consider the method as a guided walk through fields of grain, and to consider your guide a baker, rather than a proprietary farmer. I will walk you from field to field, choosing handfuls of varied grains to grind into a mixed flour. Again, I am not an expert on triticale or secale cereale, or even triticum aestivum. It's just that I've lived long enough, and travelled far enough, and studied in enough varied fields, to want to go back and sample from them when I bake. If the readers are curious and would like to consult an expert in any of these fields, they can find references at the end of each chapter.

The first section of this book explains a little bit about the history of each of the different fields, and how they have been cultivated, The second section proposes a new way of cooking, based on others, but original and possibly not to your taste. The final section of the book contains recipes for you to try at home. Should you try those recipes, I would love to know how they come out. If you choose to go further and to learn more about any combination of these fields, with this small tour as your inspiration, then I will count the tour a success. If you decide that none of these fields are for you, then I hope we can at least spend a few hours breaking the bread that I offer you here and now.

November 2014 John
Lisbon, Portugal

Foreword

I am pleased to be able to write the foreword to *Anthropology-Based Computing: Putting The Human In Human Computer Interaction* as it gives me the opportunity to introduce you to the mind of Dr. John NA Brown and tell you to be prepared for a most eclectic journey.

I first met John Brown 15 years ago. He was a professional animator and used computers and a computer mouse to develop animated features. He was frustrated by the inefficient design of the traditional mousing devices as they substantially limited control and accuracy afforded by one's hand and wrist in writing and drawing. This led to him to invent his own wireless mousing device with a dual purpose of being a device that could still point and click but also afforded the full range of anatomical freedom needed to draw and sketch with accuracy in a digital medium free from the confines of the desk. John contacted me to discuss the possibility of enrolling in a graduate program in ergonomics, so that he could learn more about the science, and to do so while immersing himself in research related to his newly invented device.

It did not take long during our first casual meeting, at a local coffee shop, to realize that I was being introduced to a person who perceives the world differently – that is he takes the time not only to stop and smell the roses, but to sketch them from every vantage point, learn from where they originated, read poetry about their relationship to romance and learn their names in several languages. This is because John has an eclectic background and spectrum of interests. He has academic degrees in anthropology, linguistics, education, biomechanics and human factors, and computer science, but more interestingly he is an accomplished artist, writer, musician and inventor as well as a self-proclaimed historian, sociologist, and world traveler. When you mash these characteristics together you get a person who can challenge you to see the world through a completely different set of lenses and help you travel down a path of thought you never before imagined navigating. Added to this, is John's ability to simplify complex issues through imaginative and metaphorically clear storytelling.

From the first chapter, you are sucked into the eclectic and thought-provoking mind of John Brown. He puts the reader at ease in his informal style, feeling like

you are sitting with him in a café enjoying a latte – but he quickly challenges you to become aware of the world around you. This is not a traditional textbook where each chapter provides a theoretical concept, but rather a journey of understanding technology and how disruptive it can be in our lives, and if not attended to can be dominant and even harmful. As I read the opening chapters, I was reminded of the disturbing statistics presented in Brigid Shulte's book *Overwhelmed*. In it she enlightens the reader on how the technology designed to make us more productive and networked is actually disruptive and rendering us less productive. She highlights research that indicates that global information consumption exceeds 9.5 zettabytes/year; 1.3 trillion hours are spent reading and writing emails; that workers change tasks every 3 min using approximately 17 programs and visiting 40 websites per day. The real disruption is realized when it is understood that for every interruption it takes 10–20 times the interruption time to return to the original task. This may result in under 30-min of uninterrupted time per day! The stats presented are only the tip of the iceberg as they represent only how our computers, emails, web browsing and cell phones are far from being calm technology. But these are but merely a few of the technologies we deal with in our daily lives.

The second and third sections of the book provide countless examples of how proper ergonomic design can lead to better efficiency but more importantly how the lack of attention to human-centred design can be disruptive and in the worst cases deadly. John provides real-life examples and entices you to try exercises that require you to think about the world around you, not superficially, but have you look from different vantage points. I promise that you will not agree with all the theories put forth, but that is alright as this is part of the ultimate goal of the book – to make you question whether the design of current technology is calm, assistive or destructive in our lives.

To enjoy the book, you need to 'Keep Calm' and take the journey through a wonderfully told story, complete with original illustrations, humour and a wealth of academic, historical, and anthropological references to defend the thesis that human-centred design needs to have human interest and calm technology as its core.

Professor and Dean in the Faculty of Kinesiology Wayne J. Albert, PhD
University of New Brunswick
Fredericton, Canada
Fellow of the Canadian Society of Biomechanics

Preface

Aren't There Already Enough Books About Computers?

Yes, yes there are… …but this book is about making them less harmful for the people who use them, and less harmful for innocent bystanders, too.

Have you ever looked up at the stars in the night sky? On a clear night, when there is little light pollution from relatively nearby sources like street lights or the moon, the view of the Milky Way can be awe-inspiring.

Have you ever looked at the night sky using a telescope? The use of the right technology enhances the experience to a phenomenal degree. It is a fantastic experience to see the rings of Saturn or to see details on the face of the moon. A telescope is very good for that, but its narrow field of view keeps you from seeing the rest of the night sky.

I'm not saying that's a bad thing. Telescopes were not designed to let you see a wide field of view – they were designed to allow you to focus in on one particular area. The limited field of view is just coincidental to the technology of aligned lenses and mirrors in a shaded tunnel that make up a telescope.

This only becomes a problem when someone decides to apply telescope design to a situation where a wide field of view is needed. Imagine that everyone around you is wearing telescopes strapped in front of their eyes. No one can see anything outside of the narrow field of view. No one can see immediately around their environment. Sure, they could learn to lip read, and so chat with distant friends, but then they'd have to learn to ignore the things in their immediate proximity. Unfortunately, the way the brain works, they would soon become convinced that they can focus on these distant interactions, quickly switching back and forth between far-away conversations, and still be aware of their surroundings. As a result, people would soon be living in a haze of incessant chatter, walking into fountains at shopping centers, and crashing their cars into obvious obstacles they hadn't even noticed.

What I'm trying to say is that even a tool that does exactly what it is designed to do should not be used in situations that do not suit every part of its design. It might be far better to design separate tools that are specifically suited to each task in question. It might be far better, but it is not what we usually do.

Even when it is possible to improve the tools, we mostly just make use of them as they are. Instead of making fundamental changes to the tool, we adapt ourselves to it, consciously or unconsciously adopting convoluted psychological, social, and physiological behaviors in order to make do.

In this book we will look at how we came to have these telescopes strapped in front of our eyes, and we will address some simple ways to improve our use of them by adapting the devices rather than ourselves.

So this isn't really a book about computers. This is a book about how to make your technology less likely to accidently interrupt, insult, injure, or kill you or anyone else.

Klagenfurt, Austria John N.A. Brown

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Glossary

ABC Ringtones These are ringtones that alert and inform the intended recipient without disturbing anyone else. This selective signal is achieved by using the individual's innate sensitivity to personally affective information as described in the Cocktail Party Effect.

Anthropogenic Describes anything initiated or caused by humans… you know, like Minamata Disease, the collapse of the Greek economy, and catastrophic climate change in the late 20th and early 21st Century.

Anthropology The study of humans, including the development of their physiology, their behaviour, and just about everything you can think of – so long as it is centered on humans.

Anthropology-Based Computing (ABC) The simple idea that computers should (and can) be designed to suit the abilities and limitations of the human body and mind. This simple idea requires that designers, computer scientists, and engineers seek the advice of ergonomists, anthropologists, psychologists, physiologists, and other experts in human factors when creating computerized tools for human use.

Ape Hominoidea, the superfamily of great apes (chimpanzees, bonobos, gorillas, orangutans, and us) and our cousins the lesser apes (like gibbons).

Bellman's Protocol In the same nonsense poem mentioned above, the captain of the ship and leader of the hunt is called the "Bellman". This is because of his unique manner of navigation. Without any knowledge of the relevant technology, the ship would simply go where it ought to when the Bellman would ring his bell. Given that the bell was an ubiquitous means of communication at the time, the name seemed appropriate for an interaction protocol that allowed the user to simply and intuitively use their phone to get what they wanted without having to learn any menus or command words.

Brown's Open Ontology for Joint User Management (BOOJUM) In the end [SPOILER ALERT] the Snark in Carrol's poem turns out to actually have been a Boojum, an invisible and unknowable creature that looks different to everyone that sees it. The seemingly simple SNARK circuit is greatly improved because –

unknown to the user – the ontology of the CASA TEVA system was designed to match user-specific phonemes and gestures to existing databases of commands and targets.

Brown's Representation of Anthropogenic Interaction in Natural Settings (BRAINS) The ABC model of three separate levels of human perception, processing, and response – by reflex, by reaction, and by reflection.

Calm Technology (CT) Calm Technology is technology with which humans can interact naturally – that is to say, technology that does not demand attention, but waits to provide service when needed and then disappears from one's attention once the service is no longer needed. To put it simply, calm technology allows you to perform your tasks without sparing any consideration for the tool.

Casa Vecchia The real-world project in which Leitner and Fercher's concepts of smart homes and wise homes were implemented in the family homes of seniors in rural and suburban Austria.

Cerebellum The "little brain" that seems to be involved in the coordination of complex reflex patterns such as the muscular activity involved in tying your shoes, riding a bicycle, or juggling. It sits in the bottom of the back of the skull.

Computerized Devices Devices that use imbedded computers – this includes most modern electronic devices: like digital watches, traffic lights, trains, planes and automobiles, and the same smartphone that just won't give you a moment's peace.

Computers The palmtop in your hand, the smartwatch on your wrist, the tablet on your table, the laptop in your backpack, the old desktop gathering dust in the corner, and the smartphone that keeps interrupting you as you try to read this glossary.

Customizable Activation of Smart-Home Appliances Through Enhanced Virtual Assistants (CASA TEVA) The Smart Home interface app that allows users to intuitively interact with any combination of embedded technologies through the exchange of peripheral and deliberate signals channeled through a smart phone, according to pre-existing mental models of either voice-centered interaction with an invisible butler or gesture-centered use of a magic wand. CASA TEVA worked overtop of the Casa Vecchia system. From the Catalan phrase: "casa meva és casa teva" (my home is your home).

Dynamic Environmental Focus (DEF) The natural human ability to gather and process multisensory peripheral information from one's environment – including one's peers – without losing the ability to concentrate on any one particular element.

Ergonomics The science of work, a field of fantastic depth combining the wide range of all the human and machine factors involved in any and every performed task. Ergonomics is the beginning of understanding what makes a tool (computerized or not) more or less useful. This is a very demanding field and, perhaps as a result, it is not uncommon for the word to be used even when the methods and standards have been ignored. The term *ergonomics* is often used interchangeably with the term *human factors*.

Evolution The process of incremental change over time in response to internal and/or external conditions. There are several theories concerning the specific means by which the change is affected, the most popular of which is Darwin's theory of natural selection.

Faith Belief without evidence – sometimes deliberately so. Strangely, *faith* is often confused with *knowledge*, even though the two of them may be considered antonyms.

General Human Interaction (GHI) Much of human interaction with computers is unconsciously based on our natural interaction with our environment – including other humans. GHI is my attempt to formalize the study and application of natural human interaction as a guideline for HCI.

Human A subdivision of Homininae, the term includes modern humans and our closest ancestors.

Human Factors Anything complex is made up of a number of different factors or contributing components. Some of these factors might be environmental, or they might be technical, or they might be categorized in many different ways. The term *human factors* embraces all of the contributing components that stem from human involvement. To put it a little too simply, rather than asking if the wheel turns, human factors asks if the wheel was made, attached, or used properly – and if it was not, then asks if the failure was due to issues of performance, training, intent, design, or anything else that is not purely mechanical or chemical. The term *human factors* is often used interchangeably with the term *ergonomics*.

Human-Centered Computing (HCC) HCC is supposed to describe HCI in which human requirements have been fundamental to the design and implementation of the system. Unfortunately, the term has been abused by those who do not sufficiently consider the mental and physical limitations of humans.

Human-Computer Interaction (HCI) The theory and practice of the cycle of communication between humans and computerized devices, encompassing software, hardware, and all of the human factors.

Intuitive Interaction Intuition is the feeling of knowledge without rational thought. It is the type of HCI that exploits the pre-existing mental models that would allow a user to perform a task without having to consciously consider the requirements of the hardware or software they are using.

Knowledge Contrary to popular belief, knowledge is the condition of *knowing* something – not *suspecting* it, or *believing* it, or *wanting it to be true,* or having faith that it simply must be so.

Limbic System Several parts of the brain at or near the edge (Latin: limbus) of the cortex. It is associated with emotion, pattern recognition, and fundamental drives for food and sex. This may be where we confound emotion with knowledge and where we generate false certainty, irrefutable opinions, and blind faith.

Natural Selection The process, according to Darwin's theory, by which the immediate adaptive value of a genotype or phenotype shapes the evolution of the species in which it appears.

Neocortex The newest part of the brain, this is where we think deliberately. It is the wrinkly "brain hat" that looks a bit like a six-layered sleeping bag that has been stuffed clumsily into its sack.

Peripheral Interaction (PI) Peripheral Interaction, in the context of HCI, relates to Weiser's call for CT. He wrote that a tool should sit unobtrusively at the periphery of the user's attention, waiting to be either ignored or brought to the center of attentive focus according to the user's decision. PI is the field of study centered on developing HCI tools that can be used (or not used) in this manner.

Prosimian *Primates prosimii*, the ancestor of our wet-nosed distant cousins the lemurs and lorises.

Protoprosimian The earliest primates with origins around 65 million years ago.

Reactive Brain According to the ABC BRAINS model, this is the part of the brain that reacts quickly, emotionally, and "without a second thought" in response to recognized patterns. It is the part of the brain that resists new information and seems to live in perpetual fear, boredom, joy, or lust. It is the part of the brain that biases us with unfounded certainty and unfounded fear. The reactive brain is the channel between the reflexive and reflective brains, filtering and reconstructing data according to established mental models. It is the part of the brain where we do most of our thinking.

Reflective Brain According to the ABC BRAINS model, this is the slowest and most expensive of our three processing systems. It is where we can think logically, perform tasks such as mathematics and reading, and take our time to develop new lines of thought. Under normal circumstances it has no direct link to the sensory system and relies almost entirely on the incomplete, poorly reconstructed, and emotionally distorted information from the *Reactive Brain*. It is the part of your brain that is reading these words, while your reactive brain is reminding you of all of the things you'd rather be doing, and your reflexive brain is insisting that your bladder is full.

Reflexive Brain According to the ABC BRAINS model, this is the part of the brain that reacts directly to simple or complex nervous stimuli. The reflexive brain is constantly in operation, perceiving and responding to internal and external stimuli and passing on only a very small amount of information to the other parts of the brain.

Scientific Method One of humanity's greatest achievements – a formal means of gathering, recording, examining, and sharing knowledge so that it can be evaluated impartially. It is difficult and requires that every participant behave ethically, setting aside their biases and preferences and ego in order to serve the advancement of human knowledge.

Scientist One who tries to apply the scientific method in their work and in their thoughts. This may or may not manifest as a paid position, depending on one's personal, academic, and professional experience, or – as we recently learned in Canada – on the political climate.

Simian From the Latin *simia*, or "ape".

Simple Hazard Identification through the Evaluation of Layered Displays (SHIELD) A modification of the CALMatrix intended for use in the identification and mitigation of hazards based on identifying mitigation strategies for each contributing factor.

Smart Home The idea that adding linked and embedded computerized devices – whether or not they are unified, and whether or not there is any artificial intelligence behind them – will improve one's living environment.

Synchronizing Natural Actions and Reacting Knowledgeably (SNARK) The model for using triple modular redundancy to resolve the issue of weak signals in natural human communication. Conscious and unconscious human linguistic output is used as input, including gestures, incidental noises, and deliberate commands. The near simultaneous occurrence of three pre-defined signals of equal value is read by the computer as a certain input. Two matching signals trigger a query. Single signals are ignored. The name is taken from Lewis Carrol's 1876 nonsense poem "The Hunting of the Snark", inspired by the fact that I had been told that there was no way to use current technology to facilitate natural, intuitive, multimodal interaction; that I was hunting for something that did not exist.

The Comparison of Attentional Levels Matrix (CALMatrix) A first useable step towards developing a scale for measuring "Calm", the *CALMatrix* is an ABC-based tool for measuring the demands made by a given task or combination of tasks on the three processing systems of the BRAINS model.

Triune Brain The idea, put forward by many theorists, that the brain can be usefully modelled as having three separate but related physical or conceptual regions, each of which is responsible for a separate type of information perception, processing, or response. The idea dates back to Aristotle's accounts of Plato's concept that each body has three souls and is reflected in the work of Freud and Jung.

Ubiquitous Computing (UC) Predicted by Mark Weiser in 1991, this is the computerized world as we know it – the state of having computers and computerized components embedded throughout our environment.

Wise Home Gerhard Leitner's concept that the next stage of the evolution of "smart" technology should be the goal of using those "smarts" wisely. A wise home will be considerate of its residents and sensitive to their changing needs and wants.